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CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 28 October 2003 with an application for Letters Patent number 529179 made by IBEX Industries Limited.

Dated 4 November 2004.

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330 High Street, Lower Hutt
PO Box 30687, Lower Hutt, New Zealand or DX SX 11129, Wellington
Freephone: 0508 4 IPONZ (0508 447 669) International callers dial: +64 4 962 2607 Fax: +64 4 550 1681 www.iponz.govt.nz

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James & Wells ref: 29258/37 CJ

PATENTS ACT 1953

PROVISIONAL SPECIFICATION

POWERED HAND TOOL

WE IBEX Industries Limited, a New Zealand company of 3/9 Allens Road, East Tamaki, Auckland, New Zealand do hereby declare this invention to be described in the following statement:

POWERED HAND TOOL

TECHNICAL FIELD

This invention relates to a hand tool and in particular, though not solely, this invention relates to a powered hand tool for use with a variety of working end attachments with varied speed and/or torque requirements.

BACKGROUND ART

Powered hand tools may have a number of size, weight and motor output considerations depending upon their use. For example, a power tool which is likely to be held and operated for extended periods of time is desirably of a weight and size which does not produce or minimises stress and muscle fatigue to an operator.

Operator fatigue while using power tools can lead to unnecessary accidents which are to be especially avoided in a workplace where individual and group safety is of prime importance. In the food industry, particularly the meat works industry, the trimming of meat from carcasses is performed by a variety of fixed cutting tools such as knives as well as smaller more manoeuvrable power hand tools.

There is a requirement of powered hand tools to provide variable output speeds and/or torque applied to implements that may be connected to the output shaft. It is also desirable that a powered hand tool provide a power output means, such as a rotating shaft, cog or gear-head which is capable of connecting with a number of tooling attachment pieces.

Meat from a carcass which remains close to joints and/or bones is useful, and can be obtained by the skilful operation of suitable cutting tools. In the past, hand knives have been used for this purpose, but more often the mechanisation of

cutting implements is being employed such that in recent times a number of hand tools with cutting implements attached have been developed. Such hand tools have been powered pneumatically from an external pneumatic compressor system, or by an electrical power system which drives a remote motor to generate rotation in a flexible shaft which extends to the cutting implement end of the hand tool. Such systems however tend not to provide efficient or effective power outputs to the hand tools, with pneumatic systems requiring suitable compressors and air filtration units to enable the necessary hygiene for a pressurised air supply; with the manoeuvrability and location of the hand tool being determined by the length of the air supply hose. Electrically driven flexible shaft systems tend to loose power through the flexible shaft delivery system, and are also strictly limited to the length of flexible shaft.

US5522142A discloses a powered hand tool in the form of a rotary knife incorporating a brushed DC motor. However, the incorporation of a brushed DC motor introduces a number of drawbacks into the flexibility of the tool and places restrictions on the operation of the tool. For example, brushed motors tend to have a reduced operational lifetime as the brushes wear out, dust can be generated from the degradation of the brushes over time (which can have detrimental affects on hygienic operations) generally are unable to run at the higher speeds (revolutions per minute r.p.m.) compared to brushless motors, and are also generally unable to supply the constant torque and speed of a brushless motor configuration.

It is therefore an object of the present invention to provide a powered hand tool which will go at least some way towards addressing the foregoing problems or which will at least provide the industry with a useful choice.

All references, including any patents or patent applications cited in this specification are hereby incorporated by reference. No admission is made that any

reference constitutes prior art. The discussion of the references states what their authors assert, and the applicants reserve the right to challenge the accuracy and pertinency of the cited documents. It will be clearly understood that, although a number of prior art publications are referred to herein, this reference does not constitute an admission that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

It is acknowledged that the term 'comprise' may, under varying jurisdictions, be attributed with either an exclusive or an inclusive meaning. For the purpose of this specification, and unless otherwise noted, the term 'comprise' shall have an inclusive meaning - i.e. that it will be taken to mean an inclusion of not only the listed components it directly references, but also other non-specified components or elements. This rationale will also be used when the term 'comprised' or 'comprising' is used in relation to one or more steps in a method or process.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

DISCLOSURE OF INVENTION

Accordingly, in a first aspect, the invention may broadly be said to consist in a hand tool comprising:

a body, the body containing a brushless DC motor, and

motor control means which controls energisation of the motor,

wherein said brushless DC motor is electrically supplied to drive a power output means connected to said motor.

Preferably, the hand tool includes a rotor position sensing means which outputs a signal which enables the position of the motor's rotor to be determined.

Preferably, the energisation of the motor is determined at least in part on the basis of the rotor position signal.

Preferably, the power output means is a shaft capable of providing a driving force to a connected implement.

Preferably, the power output means comprises a rotating shaft, a toothed wheel or cog, disc or other suitable gear head.

Preferably, the power output means includes a gearing system able to translate the power output by the shaft to a pre-determined speed or torque.

Preferably, the rotor position sensing means comprises a Hall effect sensor.

Preferably, the motor control means receives manual speed demand input and varies the output speed and/or torque of said brushless DC motor accordingly.

Preferably, a switch is provided for switching electrical supply to said brushless DC motor on and/or off.

Preferably, said switch is a non-contact magnetic reed switch located within the body which is sealed.

Preferably, the hand tool includes power input means adapted to be supplied with an input DC voltage via a connectable power cable.

Preferably, the power input means comprises a quick-release plug or socket type arrangement.

Preferably, the implement may be an implement selected from one of the following types: a rotatable circular blade, a reciprocating blade, a pair of connected reciprocating blades, a universal connection means able to attach or fit or house a tool.

Preferably, the hand tool includes heat dissipation and/or insulation means.

Preferably, the heat dissipation means are cooling fins.

Preferably, the insulation means substantially surrounds heat generating hand tool components and substantially reduces heat transfer from said hand tool body from transferring heat to an operator.

Preferably, the hand tool is constructed of metallic, plastics or composite materials.

Preferably, the body is sealed.

Preferably, the body is substantially cylindrical in shape and sized to fit into a user's hand.

BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1 is a partial cutaway side elevation of one embodiment of a hand tool according to the present invention;

Figure 2 is a partial cutaway perspective view of the power output means of Figure 1 showing the implement connection end of the hand tool, and

Figure 3 is a perspective view of the hand tool of Figure 1 with an implement attached at its implement connection end.

BEST MODES FOR CARRYING OUT THE INVENTION

A hand tool generally in accordance with a preferred embodiment of the present invention will now be described with reference to the above Figures.

In a preferred embodiment of the present invention, and with references to Figures 1, 2 and 3 there is provided a hand tool 1, with a body or housing 2 which contains a brushless DC motor 3. A motor control means, such as a controller 4 is provided to control the level of energisation level and timing to the various motor windings. An electrical power supply (not shown) is provided remotely to provide power to energise the motor. The power supply preferably outputs a DC supply voltage so that the hand tool need not include the bulk or weight of a transformer. Power is provided to the hand tool via power input means such as connector 5 and the mechanical rotary output of the motor 3 is provided via power output means or shaft 6.

The power output means or shaft 6 provides a driving force to a connected implement 7 (such as the rotary blade shown in Figure 3), although it should be appreciated that any driveable implement may be connected to the hand tool power output means or shaft 6, for example a phillips or flat-head style screwdriver bit, a drill bit or a rotating disc capable of having sandpaper or an abrasive or polishing medium attached thereto.

Power output means or shaft 6 may be configured for connection to a rotating output shaft, a toothed wheel or cog, a disc or other suitable gear head to transfer power from the motor to a connected implement requiring a power drive. Such a power drive requirement may be a rotational movement although this may be translated to drive a reciprocating blade or hammer type drive. Implements that may be connected to the power output means may for example be a rotatable

circular blade, a reciprocating blade, a pair of connected reciprocating blades or a universal connection means able to clamp, fit or house a tool.

A gearing system 7 may also be included which is able to translate the power output by shaft 6 up or down to a required speed or torque.

Electrical supply to connector 5 is via a connectable power cable or similar low voltage switching device. A quick release plug or socket type arrangement may be provided and power supplied to the motor controller or motor may be controlled manually by a user operating a switch in response to movement of handle 9 such as a non-contact magnetic reed switch 8 which may be sealed within the body 2.

The hand tool 1 may also include heat dissipation such as cooling fins and/or insulation means (neither shown) to help prevent the hand tool or body 2 from overheating and transferring excessive heat to a user. In one embodiment of the present invention the brushless DC motor has thicker than usual external walls which have greater capacity to absorb heat generated from the motor. The insulation means may substantially or wholly line the interior of the hand tool body 2, although if such a system is used, it is appreciated that heat dissipation such as venting is required to help remove heat from motor operation, especially if the hand tool is a sealed unit.

A sealed body unit may provide a number of advantages, such as its ability to prevent dust and moisture entering the body and interfering with the motor, power control system or electrics which may render the hand tool unsafe for operation by a user in a wet environment. For example, a hand tool used within the meat works industry; where blood and other meat juices are prevalent, or in an industrial environment where use of power tools exposed to rain and/or humidity is likely to occur (for example on a construction site); it is desirable to provide a waterproofed system less likely to provide electrically unsafe operating conditions. This safety

may be further enhanced by the inclusion to the hand tool system of an isolated power transformer, such as a 24 to 36 volt DC supply with overload protection. Such a transformer can be remotely mounted away from the operator, hand tool and wet conditions.

Further, as the switch is of the non-contact variety, the body 2 may be better sealed off from the external environment as no special seal is required around the switching apparatus.

A number of advantages exist due to the incorporation of a brushless DC motor within a hand tool body. For example, brushless DC motors in general tend to provide longer tool life durability, do not generate dust (which would otherwise be generated by the brushes of a brushed DC motor), are able to run at higher speeds more efficiently whilst also providing more constant torque and speed compared to brushed DC motors.

The brushless DC motor can also be designed with customised windings to achieve desired torque output, and include modified power output means able to accept and be coupled with a planetary gearhead. The planetary gearhead may be used to gear down the output speed of the motor in order to achieve required torque and to maintain a more constant speed for user comfort.

A brushless DC motor can overcome disadvantages with a number of pneumatic and electrically powered flexible drive shafts. For example, pneumatic units require a supply of high quality compressed air (which can be costly to provide and the hand tool power output can fluctuate with variations in air supply and motor wear. Pneumatic units can often be subject to high levels of vibration, which when transmitted to a user creates an undesirable level of discomfort, and may also generate noise if not muffled effectively.

Electrically powered flexible drive shaft units generally require 240 or 110 volt AC supply which may unnecessarily increase the risk of electric shock injury. Also, users tend to be restricted in their reach with the tool which is governed by the length of the flexible shaft, and may not have a hand tool on/off control system which can make them inherently more dangerous, especially if dropped when in use. The flexible shafts are also a maintenance concern. These types of hand tools also tend to have restricted movement due to the limited range of bending radii of the flexible shaft, and may also be subject to excess vibration. Due to the nature of the electrical power supply generally required there are strict earthing requirements for the hand tools, and different standards of electrical configuration due to different supply voltages can also be overcome by a motor able to be varied by the voltage input.

Previously, brushless DC motors have not been considered for incorporation in hand tools. The applicant has however determined that there are a number of benefits to be obtained by incorporating a brushless DC motor in a powered hand tool and has managed to overcome various difficulties (both assumed and actual) in incorporating a brushless DC motor within a powered hand tool having dimensions suitable to allow the tool to be hand held. For example, miniaturisation of the motor has been necessary but it is expected that it will be possible to produce a hand tool which is substantially cylindrical in shape having an outer diameter of between 40 to 45 mm, preferably 42 mm and a length of 15 to 20 cm.

The present invention also provides for a hand tool with a power output means which is adapted to drive multiple different connectable implements such that the hand tool becomes the centre of a modular hand held power tool system. The brushless DC motor and gearhead (having a ratio of about 5.2:1) may provide an output shaft rotational speed of about 3000-5000 r.p.m. with torque of about 880 gf.cm, dependent upon the desired application. The actual motor r.p.m. could vary

between 20,000-30,000 r.p.m., with the motor speed being controlled via the input voltage to the controller, the controller itself, or alternatively via the use of a different geared system. Similarly, torque can be varied depending on the gearing system used.

This invention is designed to overcome a number of disadvantages of existing hand tools, specially in regard to brushed DC motor or pneumatically driven power configurations.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

IBEX INDUSTRIES LIMITED

by its Attorneys

JAMES & WELLS

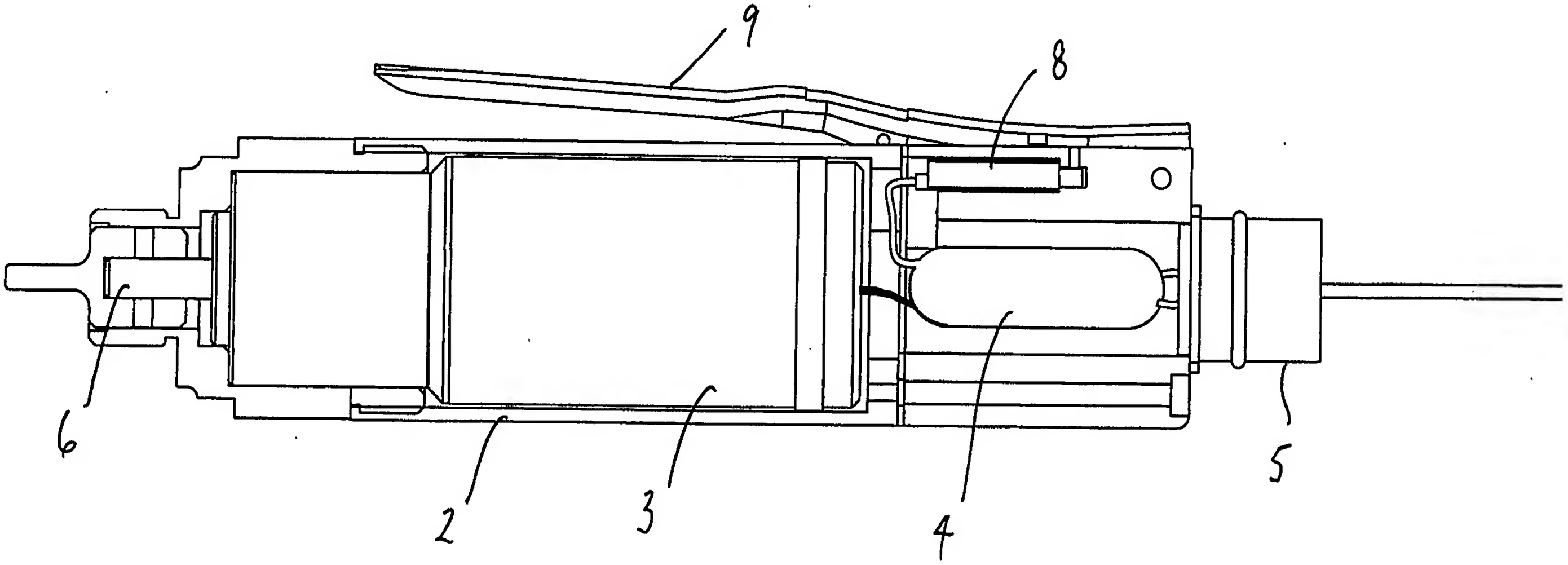
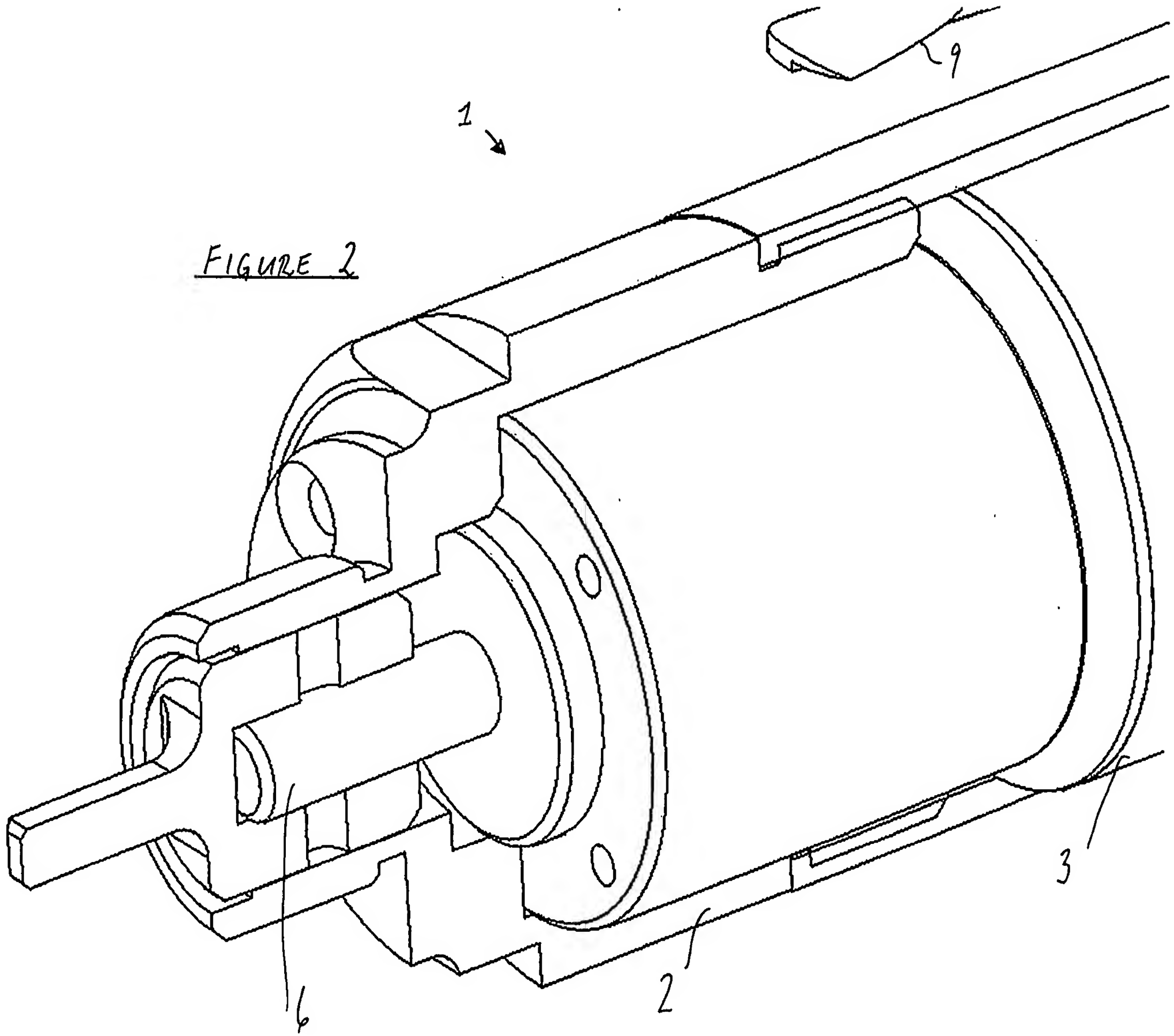


FIGURE 1

FIGURE 2



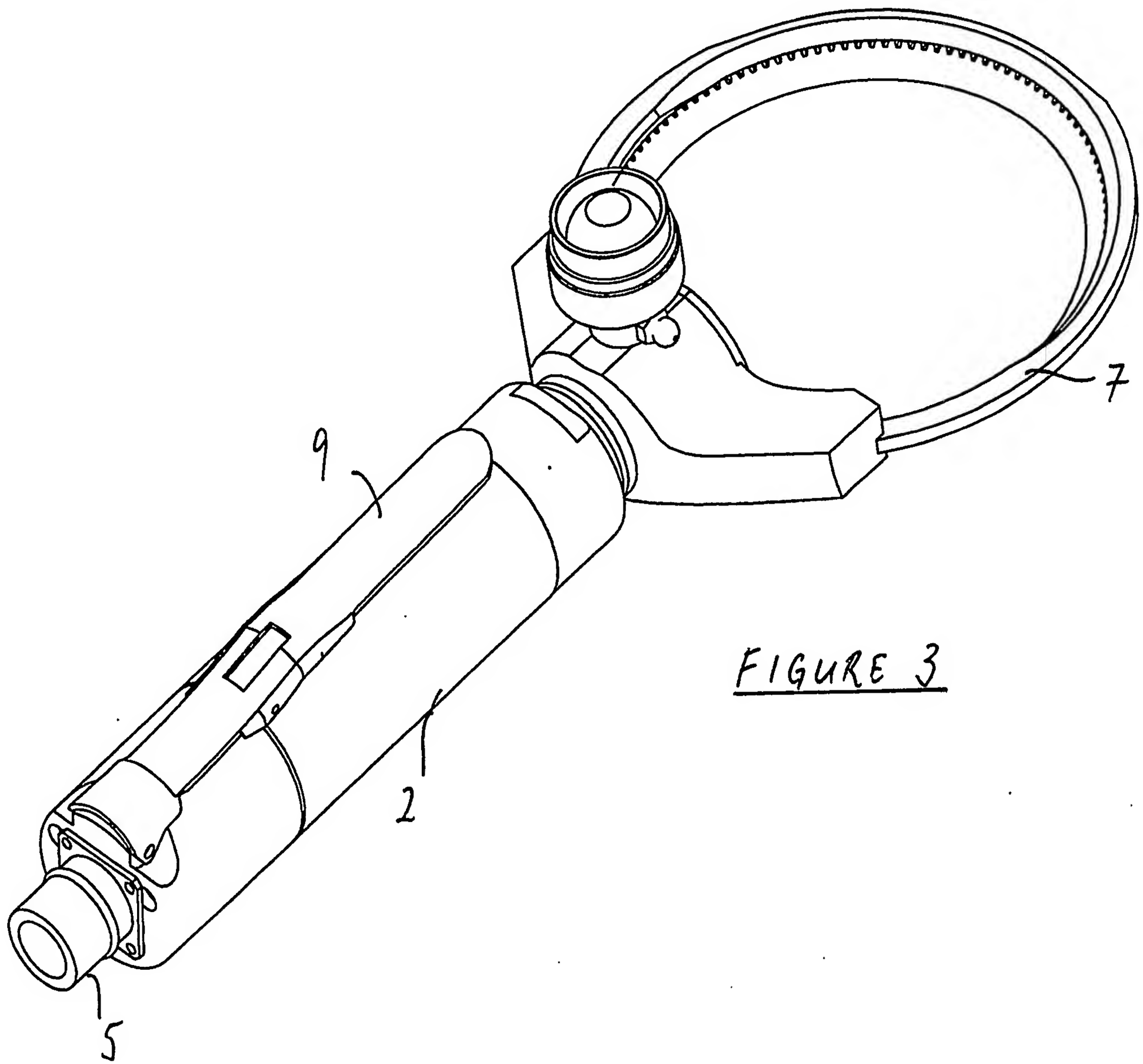


FIGURE 3